NISTTech

High Nitrogen Stainless Steel

Produces strong, hard, ductile and corrosion resistant stainless steel alloy powder

Description

NIST's High nitrogen stainless steel (HNSS) alloys, made from powder and consolidated by Hot Isostatic Press (HIP), are revolutionary materials. Utilizing the Powder Metallurgy – Rapid Solidification Processing (PM-RSP) method minimizes segregation, yields ultra homogeneous composition, and 100% density. Additionally, using NIST's process model prevents the formation of stable nitrides and sigma phases found in other alloys of this type. These alloys are simultaneously hard, very strong, ductile and highly corrosion resistant. In addition, the high work hardening coefficient allows for the enhancement of the mechanical properties even further via cold deformation. The elimination of sigma phase and subsequent solution heat treatment implies that thicker sections can be formed than from other competing ingot metallurgy alloys." NIST's HNSS, with an excellent assortment of properties, has the ability to be used in a vast variety of industries. The material's potential applications are limitless. It can be utilized in but not limited to the following industries: aerospace (engine cowlings and landing gear), marine (shafts and propellers), military (personnel and heavy armor), medical (hip and knee prostheses, angioplasty stents, and medical screws and fixtures) and electric power generation (retaining rings).

Applications

- **Overall Medical**
  NIST high nitrogen stainless steel can be used in implant applications such as orthopedic implants, hip and knee prostheses, angioplasty stents, screws and fixtures
- **Implants and Drug Delivery**
  The stell consists of the same constituents as 316L, which is already approved by FDA for medical implants, NIST HNSS has higher strength and improved corrosion resistance Additionally, NIST HNSS can be consolidated to retain some porosity This retained porosity could be used for drug delivery and to promote tissue ingrowth. Thus vital drugs can be delivered to critical areas reducing patient discomfort and hastening recovery. Other potential applications are in stents for angioplasty and scaffolding for cartilage retention.

Advantages

- **List of Benefits**
  • High strength, UTS of 1100 MPa, (150 Ksi) and Rockwell C30 hardness in annealed condition • Grain size between 5 µm and 20 µm after HIP consolidation (Hall-Petch Relationship) • High ductility (up to 60 % elongation) • High strain-hardening exponent (?0.2) • Thicker cross-sections than conventional high strength SS • Outstanding corrosion properties: • Pitting temperature of 304L and 316L SS is 0 ?C, NIST HNSS is greater than 75 ?C and 600 mV improvement over 316L for pitting resistance in Hank's solution • 100 % theoretical density • Nitride, ?, and ? ferrite phases eliminated • Exceeds the performance of 316L stainless steel in all applications • The impact energy for the material can be as high as 140 J (103 ft•lbs)

Abstract

Disclosed is a high nitrogen stainless steel alloy and alloy powder comprising chromium (Cr), molybdenum (Mo), manganese (Mn), nickel (Ni), nitrogen (N) and iron (Fe). The composition of the stainless steel alloy and powder comprises between about 27 and about 30% by weight Cr, between about 1.5 and about 4.0% by weight Mo, Mn present and is present in an amount up to 15% by weight, at least about 8% by weight Ni, and about 0.8 to about 0.97% by weight N with the balance being iron. It has been discovered that forming an alloy of this chemistry using nitrogen gas atomization process, followed by a consolidation process, the alloy is less likely to form detrimental ferrite, stable nitride and sigma (.sigma.) phases, without the need for further processing, such as solution treating and quenching. This allows for the formation of stainless steel articles having a thicker cross-section with reduced processing cost.

Inventors

- Biancaniello, Frank S.
- Jiggetts, Rodney D.
- Ridder, Stephen D.

References

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Status of Availability

patent active and available for licensing

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